# FUSED LATERITE IN A CALDERA NEAR SKIPTON, WESTERN VICTORIA

By P. L. C. GRUBB

CSIRO Mineragraphic Investigations, Melbourne

## Abstract

Two small orange-coloured inclusions found in a highly porous cinder ash flow on the N. flank of a small caldera in W. Victoria are considered to be partially fused laterites.* Although essentially glassy in nature, some detrital quartz, zircon, sodic plagioclase, plus metakaolin can be recognized, yet the sole high-temperature mineral present comprises a trace of cristobalite. These facts, together with the conspicuously dehydrated nature of the inclusions, suggest their submission to high temperatures, though not exceeding 950°C.

* The term 'laterite' is adopted for the material described on account of its distinctive mineralogy and high proportion of hard ferruginous pisolites.

## Introduction

In a small but well-preserved volcanic caldera just N. of Skipton in W. Victoria, two 6-8 in. orange-coloured bomb inclusions were found exposed in the semi-consolidated coarse steeply-dipping ash flow forming part of the caldera's N. flank. These inclusions possessed a conspicuous hackly fracture with a semi-vitreous lustre on fresh surfaces while, in addition, several small $\frac{1}{8}$-$\frac{1}{4}$ in. hematite pisolites are recognizable.

## Microscopic Data

An examination of thin sections and polished surfaces of the fused laterites has shown that these consist essentially of an isotropic glass with an abundance of finely disseminated hematite particles, whereas the remaining components include detrital quartz grains plus accessory zircon, magnetite, sodic plagioclase, and pyrite. Through partial recrystallization, however, the hematite pisolites possess a poor zonal structure showing more coarsely crystalline margins enclosing cores of earthy texture.

## X-ray Diffraction

Owing to the predominantly glassy nature of the fused laterites, background counts for all wave-lengths were characteristically high, thus effectively reducing the maximum resolution power of X-ray powder diffraction traces for these samples. Nevertheless, strong diffraction peaks could be indexed for both quartz and hematite plus additional traces of metakaolin and cristobalite.

Estimations of the total quartz content obtained by the phosphoric acid method indicated a value of 29·5 per cent. Hence, as the total silica content is 65·8 per cent (Table 1), this may be taken as still further evidence of the predominantly glassy nature of these laterites. An approximate estimate of their modal composition is shown in Table 2.

## Chemical Analyses

Chemical analyses reveal little similarity between the baked Skipton laterite and that of a typical laterite derived from the Newer Basalts in the area (CSIRO Min. Rept No. 869). The most conspicuous feature of the former is the extremely low combined-water content, which probably arises from the intense baking in the

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TABLE 1

*Chemical analysis of a baked laterite bomb from the Skipton caldera,
W. Victoria*

|  | % by wt |
|---|---|
| $SiO_2$ | 65·80 |
| $Al_2O_3$ | 18·88 |
| $Fe_2O_3$ | 10·24 |
| $TiO_2$ | trace |
| $H_2O$ (+105°C) | 1·87 |
| $H_2O$ (−105°C) | 3·76 |
| Total | 100·55 |
| % free silica as quartz | 29·50% |

TABLE 2

*Estimated mineralogical composition of Skipton baked laterite, W. Victoria*

|  | % by wt |
|---|---|
| Quartz | 29·50 |
| Hematite | 10·60 |
| Metakaolinite | 13·70 |
| Glass and cristobalite | 46·00 |
| Total | 99·80 |

caldera. This apparently resulted in the conversion of goethite to hematite, some quartz to cristobalite, and partial vitrification of quartz, felspar, and kaolin. Thus, the changes involved were very similar to those encountered in comparable ceramic products after firing (Williamson 1949).

### Conclusions

Local occurrences of fused clays, laterites, and shales are not uncommon in Victoria; these, for the most part, being associated with local burn-outs in coal seams or even in hollowed tree trunks where draught conditions were at an optimum. The mineral assemblages produced under these conditions are generally of an extremely high-temperature nature and often comparable with those encountered in certain blast furnace linings (CSIRO Min. Rept No. 864) while, in addition, they are also often distinctly slaggy in appearance.

As these characteristics are almost completely lacking in the fused Skipton laterites, an attempt was made to estimate their approximate thermal history by heating two related lateritic products for set periods at varying temperatures in a muffle furnace. The products of each successive run were examined microscopically and by X-ray diffraction, the results being listed in Table 3.

The most significant features noted in these are:
(1)  no vitrification was observed below 800°C;
(2)  cristobalite was detected only at about 1000°C (similar temperatures of formation being also commonly observed in ceramic products);
(3)  although the usual phases formed at temperatures between 800°C and 1000°C, both in these runs and in those carried out by Glass (1954) and by Bradley and Grim (1951), are mullite and corundum, neither of these constituents were detected in the baked Skipton laterites.

In conclusion, therefore, despite the absence of any detectable corundum or mullite, it seems evident that the two laterite bombs were subjected to high tempera-

TABLE 3

*Mineralogical changes observed in lateritic products at varying temperatures*

| Starting materials | Temperature °C | Time hr | Mineral phases identified | Remarks |
|---|---|---|---|---|
| Laterite (mottled) from Hamilton, Victoria | 600 | 2½ | $\chi - Al_2O_3$ kaolinite quartz | Moderate darkening of laterite to a deep brown colour |
| | 800 | 4 | $\chi - Al_2O_3$ hematite quartz | Incipient fusion with occasional thin glassy selvages |
| | 1000 | 2 | mullite cristobalite hematite | Predominantly glassy indicating total fusion |
| Unconsolidated 'earthy' bauxite from Jarrahdale, Western Australia | 600 | 1¾ | $\chi - Al_2O_3$ quartz | Little change evident |
| | 800 | 2 | $\chi - Al_2O_3$ corundum quartz | Pale buff friable product, little or no glassy fusion evident, well formed quartz crystals conspicuous |
| | 1000 | 1 | corundum quartz trace of cristobalite | Pale buff friable product, no glassy fusion evident, secondary growth of quartz crystals very conspicuous |

tures though not exceeding 950°C. They were intensely dehydrated, and even the small percentage of water present may be partly due to subsequent 'moisture expansion', a feature commonly encountered in fired ceramic products after cooling (Williamson 1949).

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